RESEARCH LINKING PHYSICAL ACTIVITY AND COGNITION

1. In a study of 214 sixth-grade students Coe et al. aimed to determine the effect of physical activity on academic achievement. Engagement in moderate to vigorous physical activity (MVPA) was compared with grades from four core academic classes as well as standardized test scores (Terra Nova percentiles). Students who either performed some or met Healthy People 2010 guidelines for vigorous activity (20 minutes per session on three or more days per week) had significantly higher grades than students who performed no vigorous physical activity in both semesters. [Vigorous physical activity is defined as rhythmic, repetitive physical activities that use large muscle groups at 70 percent or more of maximum heart rate for age. Examples of vigorous physical activities include jogging/running, cycling, aerobic dancing, skating, rowing, jumping rope, cross-country skiing, hiking/backpacking, racquet sports, and competitive group sports such as soccer.]

> Coe, D.P., Ivarnik, J.M., Womack, C., J., Reeves, M.J., & Malina, R.M. (2006) Effects of physical education and physical activity levels on academic achievement in children. *Medicine & Science in Sports and Exercise*, 38, 1515-1519.

2. Castelli et al. found that among 259 third and fifth graders from four Illinois middle schools, field tests of physical fitness were positively related to academic achievement. Specifically, aerobic capacity was positively associated with achievement, whereas BMI was inversely related. Associations were demonstrated in total academic achievement, mathematics achievement, and reading achievement, thus suggesting that aspects of physical fitness may be globally related to academic performance in preadolescents.

> Castelli, D.M., Hillman, C.H., Buck, S.M., and Erwin, H. (2007) Physical fitness and academic achievement in 3rd and 5th grade students. *Journal of Sport and Exercise Psychology*, 29, 239-252.

3. In a Quebec study, Trudeau and Shepard concluded that given competent providers, physical activity can be added to the school curriculum by taking time from other subjects without risk of hindering student academic achievement. On the other hand, adding time to "academic" or "curricular" subjects by taking time from physical education programs does not enhance grades in these subjects and may be detrimental to health.

> Trudeau F, Shephard RJ. (2008) Physical education, school physical activity, school sports and academic performance. International Journal of Behavioral Nutrition and Physical Activity, 25; 5:10.

4. Davis et al. tested the effect of aerobic exercise training on executive function in overweight children. Executive function includes skills important for planning and organizing, problem solving, concentration, resisting impulses, and using strategies to achieve goals. The children in the high volume activity group (40 minutes per day, 5 days/week for 15 weeks) had significant improvement on an executive function test compared with the control group (no physical activity). Those in the low volume group (20 minutes per day, 5 days/week for 15 weeks) showed about half that improvement. The researchers also performed brain scans and found that the children who were exercising appeared to have more neural activity in the frontal areas of their brains, an important area for executive function.

> Davis, C.L., Tomporowski, P.D., Boyle, C.A., Waller, J.L., Miller, P.H., Naglieri, J.A., & Gregoski, M. (2007) Effects of aerobic exercise on overweight children's cognitive functioning: a randomized controlled trial. *Research Quarterly of Exercise and Sport.* 78(5): 510-9.

5. Grissom evaluated the relationship between physical fitness and academic achievement. To do so FITNESSGRAM physical fitness test scores were compared to reading and mathematics scores on the standardized achievement tests. Subjects included all 5th, 7th and 9th grade students in California public schools in 2002 for whom there was a complete set of data. The researcher found that as overall fitness scores improved, mean achievement scores also improved. The relationship between fitness and academic achievement appeared to be stronger for females than males and stronger for higher socio-economic status (SES) than lower SES students.

Grissom, James. (2005) Physical fitness and academic achievement. *Journal of Exercise Physiology online.* v8, n1.

6. In 2004 Naperville Central High School in Illinois began a "learning readiness" physical education program. Students identified as underperforming in literacy were offered an early morning physical education session immediately followed by a literacy support class. By the end of the semester, it was found that the students who took part in both the early morning physical education class and the literacy intervention gained 1.34 years of improvement on a standardized reading test. Their peers who did not participate in the physical education class prior to literacy instruction made only made about 0.7 years of improvement. The school then followed this approach for mathematics instruction. The results were even more impressive. Students who exercised prior to the math intervention class increased their standardized algebra test score by 20.4 percent compared with their peers in the control group who only made 3.87 percent improvement.

Viadero, Debra. (2008) Exercise seen as a priming pump for students' academic strides. Education Week http://www.edweek.org February 12, 2008.

7. The brain benefits in many ways from exercise. Specifically, aerobic exercise has been shown to increase blood flow to the brain, which has several effects. Blood vessels are stimulated to grow which increases the brain's access to energy and oxygen. This increased blood flow has been shown to specifically stimulate the dentate gyrus, an area of the brain which aids in memory formation. Blood flow also reduces brain-bound free radicals slowing normal degradation of neurons. Exercise also increases production of a chemical called brain-derived neurotrophic factor (BDNF). BDNF is responsible for neuron's creation, survival, and resistance to damage and stress, all of which support learning. Some scientists think of BDNF as "Miracle-Gro" for the brain. BDNF is also found in the hippocampus, an area directly recruited during learning.

Medina, John.(2008) http://www.brainrules.net/exercise

Ratey, John.J., and Hagerman, Eric. Spark - The Revolutionary New Science of Exercise and the Brain. New York: Little Brown and Company, 2008.